TR-888

operations and service manual

techni-rite
ELECTRONICS
INCORPORATED
TECHNI-RITE INDUSTRIAL PARK - WARWICK, R. I.

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(supersedes L-359)

OPERATIONS AND SERVICE MANUAL

Model TR-888

EIGHT CHANNEL RECORDER

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I. DESCRIPTION

A. General

The Techni-Rite Recorder, Model TR-888 is a compact, eight channel direct-writing analog recorder.

The writing is done by the use of a heated stylus (for each channel) which puts pressure on a heat-sensitive paper producing a trace. The stylus heat can be varied which thereby varies the trace width. The recorded chart can be safely stored at temperatures up to 140°F. Reproducible chart paper is also available.

Each of the eight analog recording channels can be "programmed" to record a wide range of input signals, including DC signals, AC signals up to 125 Hz, and inputs from a variety of transducers. No internal electrical realignment is necessary when changing from one type of signal conditioner to another. Each Model TR-888 recorder is supplied with eight plug-in signal conditioners (of the customer's choice). The recorder has eight selectable paper speeds. Event markers are also available.

B. Specifications

NUMBER OF CHANNELS	EIGHT analog
EVENT MARKERS	right hand standard; left hand optional
FREQUENCY RESPONSE	DC to 125 Hz
RISE TIME	4 to 5 MS; 1% overshoot
CHART SPEEDS	Eight: .5, 1, 2.5, 5, 10, 20, 50, 100 mm/sec.(±10 and ±60 optional)
CONTROLS	Main Power, Chart Speed, Trace Width
CHART PAPER	Eight 40 mm wide channels, each ruled with 50 lines; 200' long
STABILITY	0.5 DIV/10°C to 40°C
DIMENSIONS	17½"W X 19"H X 6"D
WEIGHT	65 lbs.(with 8 conditioners installed)
POWER REQUIREMENTS	115 VAC/60 Hz, 300W (50 Hz/220 V, 400 Hz, also available)
ELECTRONICS	Recorder accepts any "mix" of plug-in signal conditioner manufactured by Techni-Rite.

C. System Breakdown (Assemblies)

1. The following comprise the basic recorder chassis:
   a) Chart Transport Mechanism
   b) Chart Mandrel Assembly
   c) Dual-Speed Chart Drive Motor
   d) Four-Speed Constant Mesh Chart Speed Transmission
   e) Heavy Duty Stylus Heat Transformer
   f) Power Transformer for each Analog Channel (8)
   g) Integrated Pen Motor/Amplifier for each Analog Channel (8)
   h) Control Circuitry

2. Each recorder is equipped with eight signal conditioners.*

3. List of Equipment and Accessories Supplied:

The recording system comes in a single shipment of two cartons: The larger carton weighs 75 pounds and contains the recorder and line cord with signal conditioners installed. The smaller carton weighs 12 pounds and contains the following:

   a) 1 chart mandrel assembly
   b) 1 set of nine mating input connectors (8 for analog inputs, 1 for event input)
   c) 1 accessory maintenance tool kit containing 1 stylus installation tool and 1 pen motor damping alignment tool.

Any other accessories, if ordered, will be shipped in separate cartons.

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* For TSC-50 Instruction Manual, see L-390.
  TSC-500 " " see L-391.
  TSC-801 " " see L-403.
  TSC-810 " " see L-404.
  TSC-5 & 510 " " see L-365A (supersedes L-365).

II. INSTALLATION

A. General

The TR-888 recorder is a portable instrument but can also be mounted in a rack using a rack-mounting adaptor available as an accessory. Instructions for this type installation are included with the rack-mounting adaptor kit. (See Section IX, Figure 9-4).

As a portable unit, the recorder can operate with its writing table in the vertical or the horizontal plane, that is, with the recorder standing upright or lying flat. In this type application allow at least 2 inches clearance between the recorder side plates and adjacent equipments so that air circulation can permit heat to dissipate from the recorder and its signal conditioners.

The TR-888 recorder may also be hung on a wall using heavy duty screw eyes or hooks which support the recorder by its carrying handle which is located on top of the recorder. Note that the TR-888 should not be permanently fastened to a wall as access to the rear of the recorder is required to replace fuses and perform maintenance.

B. Wiring Input Connectors

Use only shielded cable when making up cables to connect signal inputs to the TR-888. The TSC-5 strain gage signal conditioner requires double-shielded cables or two separately shielded cables. The TSC-50, TSC-500, TSC-810 and the TSC-801 signal conditioners require a double-conductor shielded cable. The shielded cable should be of good quality such as produced by Belden (PN 8451-1000).

To determine the appropriate connector pin numbers see the following Input Connector Wiring Table:

INPUT CONNECTOR WIRING TABLE

Signal Conditioner Model Number	Non-Inverting Input	Common	Inverting Input
TSC-801	1	3	2
TSC-810	1	3	N/A
TSC-50	1	3	N/A
TSC-500	1	2	N/A
TSC-5	See TSC-5 Manual (L-365A).		

EVENT MARKERS

Install a normally open switch of 500 ma contact rating between the connector pins listed below. The switch can be either a toggle or push-button type.

Right hand marker, Pin 1 and Pin 3
Left hand marker, Pin 4 and Pin 5

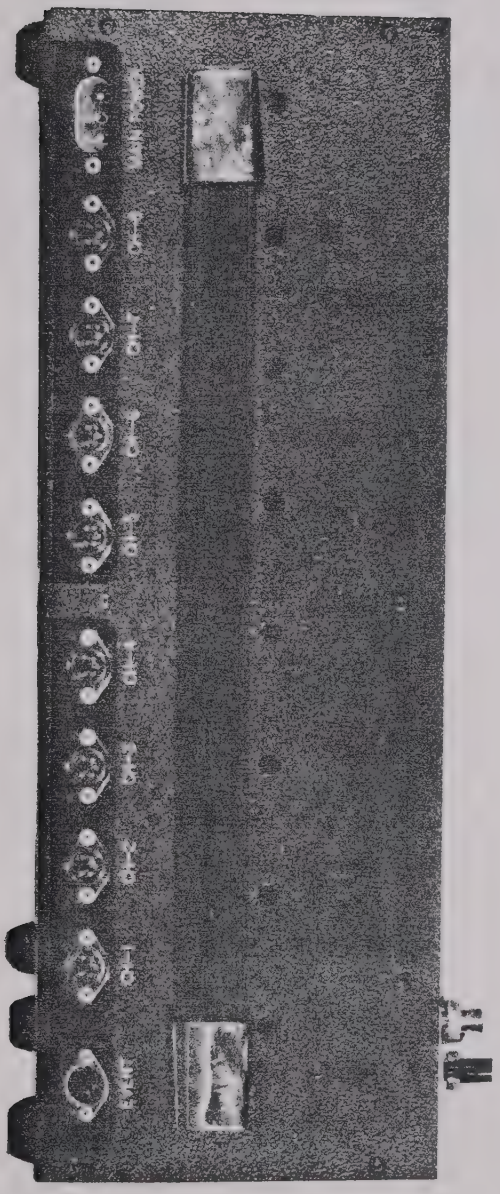

FIGURE 2-1. Recorder, top view, showing signal input connectors for analog and event channels

C. Preparation of the End of the Shielded Signal Cable. (See Figure 2-2 (A) (B) and (C)).

1. Remove 1¼" length of the outside plastic sheathing. (A)
2. Remove 3/4" length of the metal shielding layer.
3. Strip off 3/16" insulation from each of the 5 inner conductors which are to be used. The green wire is not used. Twist and tin with solder each of the inner conductors. Form each inner conductor into a hook.
4. To prepare the input connector, disassemble the molded insert (C) from the outside metal shell by unscrewing the clamping screw (B).
5. Slide the metal shell and rubber strain relief assembly onto the prepared signal cable.
6. Note that the connector pin numbers are molded onto the inside end of the insert; insert each signal wire into the appropriate solder connector of the insert. Crimp each signal wire and solder.
7. Note the U-shaped shield clamp; lay the exposed portion of the shield into the clamp, allowing a slight amount of extra signal lead length between the soldered signal wire connections and the shield clamp.
8. Using a pair of long-nosed pliers, carefully bend the ends of the shield clamp over the cable shielding, then firmly clamp the cable shield into place using slight additional pressure from the pliers.
9. If extended operation in corrosive atmospheres is contemplated, the cable shield should be soldered to the shield clamp. Care should be taken to avoid melting and shorting together of the inner conductors due to excessive heat.
10. Before reassembling the cable, carefully inspect the entire assembly to verify that no wires are shorting together; then slide the metal shell down over the inserts and reinstall the clamping screw.
11. The shielded signal cable is now ready to use.

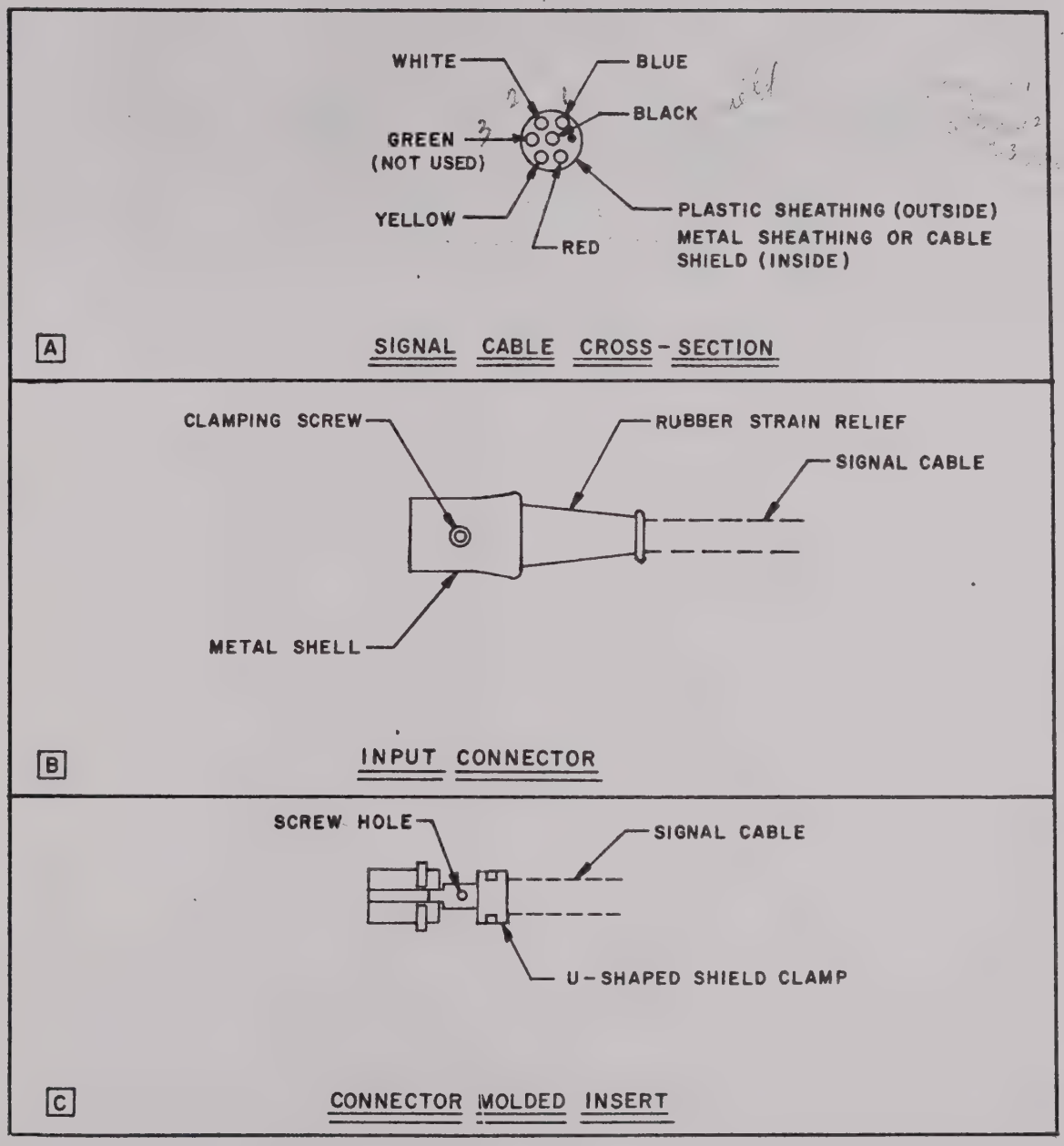

FIGURE 2-2. Diagram of Shielded Signal Cable

D. Connecting Recorder to Power

Power connection is made to the recorder with an 8-foot detachable power cable. The power cable is supplied with the recorder complete with 3-wire grounding plug when the recorder is designed to operate on 105 - 125 volts AC, 60 Hz power. The detachable power cable is supplied less male power plug when the recorder operates on any other line voltage and frequency. In this case, the end of the power cable is stripped and the wire ends are tinned so that the customer may attach his own connector.

When such a recorder is supplied, connect the power cable wires as follows:

Wire Color	Connect to
Black	AC Hot
White	AC Neutral
Green	Earth Ground

III. OPERATION AND CALIBRATION

A. Operation

1. Controls and Indicators

There are three controls on the recorder frame.

CONTROL NAME	CONTROL FUNCTION AND SENSE OF OPERATION
CHART SPEED	A rotary switch; select speed at which chart passes over the writing edge. OFF position allows recorder warm-up and some rough alignment procedures without using chart paper. Turn the CHART SPEED CONTROL to the desired position.
MAIN POWER	A push-button; push for ON; push for OFF. MAIN POWER indicator lamp will light to indicate that the recorder is receiving power.
TRACE WIDTH	A rotary potentiometer control for vernier adjustment of stylus heat or trace width. Nine trace width controls are supplied; one for each analog stylus (8), and one control for the event marker trace width. These controls are to be adjusted for best writing while the recorder is in operation recording an actual signal. Turn controls clockwise (CW) to increase trace width.

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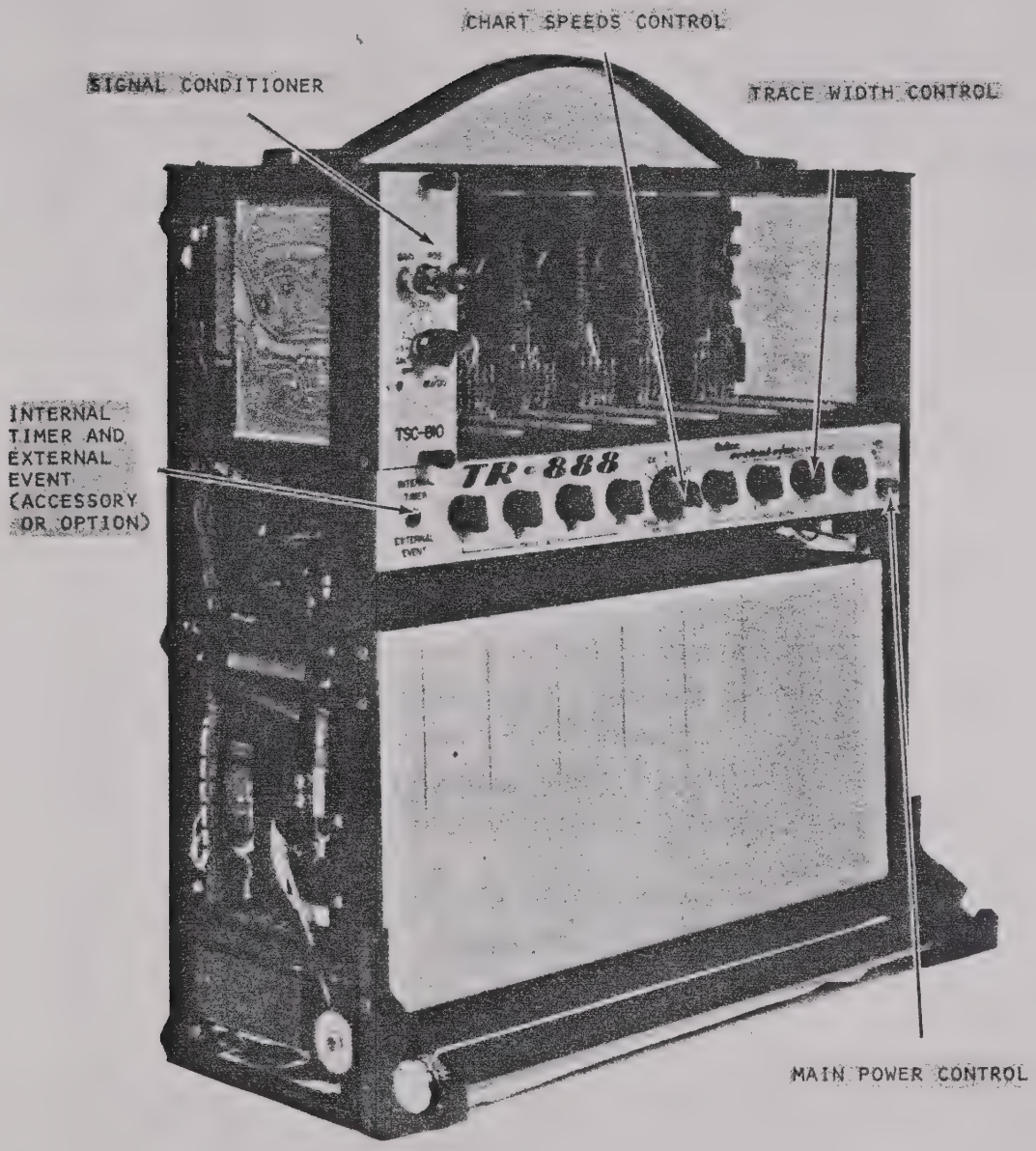

FIGURE 3-1. Front panel controls for Model TR888 8-channel recorder showing one signal conditioner installed

2. Loading Chart Paper (See Figures 3-2, 3-3, 3-4.)

(NOTE: If the empty mandrel is in the recorder, start paper loading procedure with paragraph c.)

a) With unloaded chart mandrel in one hand, unscrew and remove the left hand plate from the mandrel. (NOTE: This part has a left hand thread.) Place the left hand plate to the left and the mandrel to the right. (See Fig. 3-2.)

b) See Figure 3-3. With the mandrel (1) held in the right hand, slide the chart paper onto the mandrel so that the paper uncurls from the bottom with the printed side facing up (2). Replace the left hand plate (3) by screwing it on to the mandrel while at the same time being sure that the drive pins (4) fit into the slots in the chart paper spool (5).

c) It is advisable for easier loading, to place the recorder in the vertical position when possible. Note the two protruding handles located at the upper left and upper right hand extremities of the writing table. Grasp both handles between the thumb and forefinger and pull straight out. This will disengage the writing table from its two snap-type locks. The writing table is thereby swung out and down to a horizontal position. See Figure 3-3.

d) Note the left and right hand chart mandrel brackets located at each end of the chart magazine. Slide both locking bars fully upward.

e) Insert the loaded mandrel straight into the left hand and right hand brackets and fully slide both locking bars down into place.

f) Unroll 1½ to 2 feet of chart from the chart roll, bring it over the writing table edge, carefully close the writing table making sure it has snapped into place. (Unless these locking bars are in place properly, the writing table will not close.)

g) Turn on MAIN POWER and set chart speed generally to the fastest speed to permit quick paper alignment. Tear the end of the chart paper to form a V-shaped leader. Slowly feed approximately three (3) inches into the chart loading slot. The drive mechanism will then couple to the end of the paper and feed it automatically out through the exit slot. See Figure 3-4.

h) Allow the chart paper to run through the recorder for 3 to 5 feet (at the suggested fast speed) or until the chart is running straight and free within the drive mechanism.

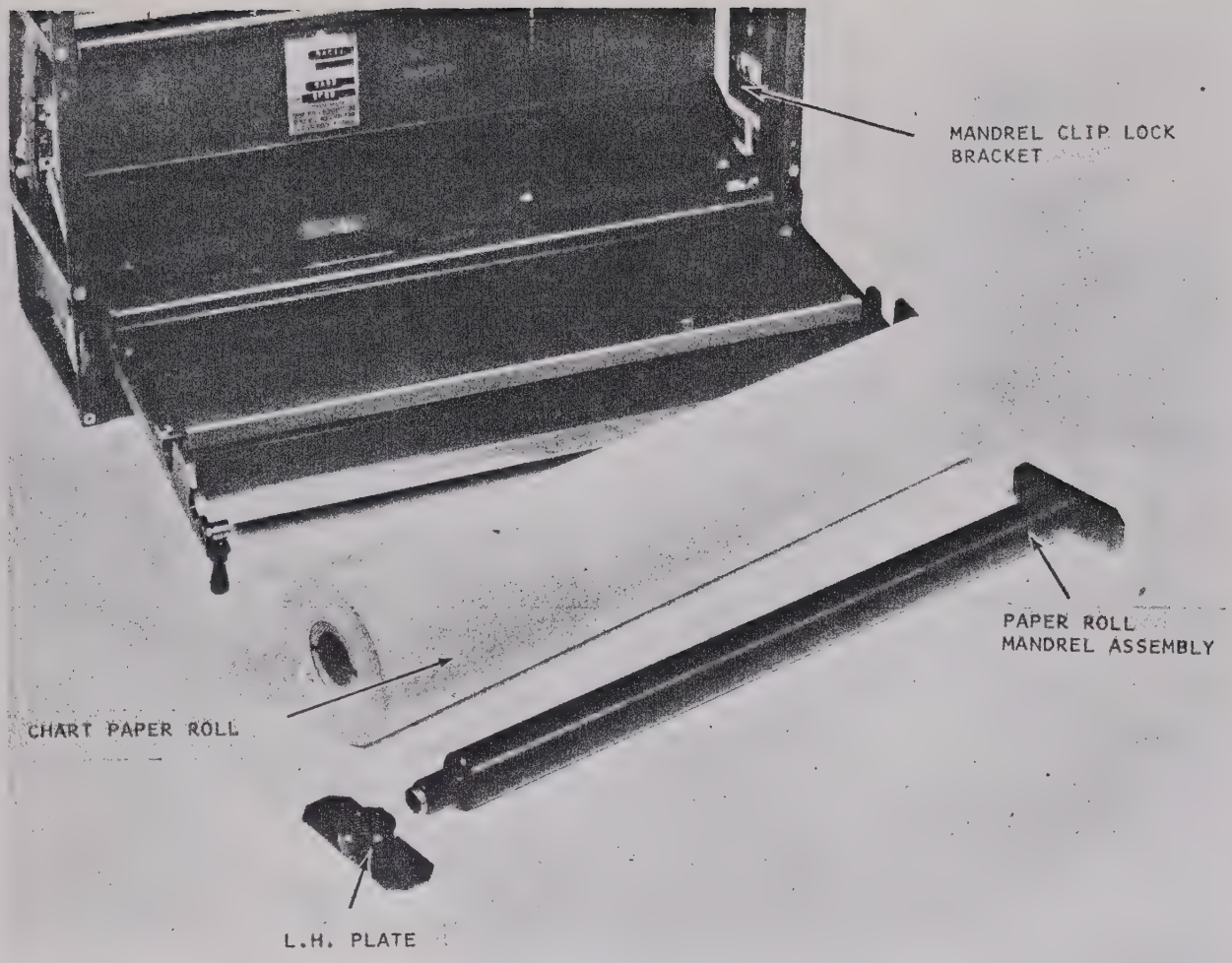

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FIGURE 3-2. Chart loading, Step 1

FIGURE 3-3. Chart loading, Step 2, by order of assembly

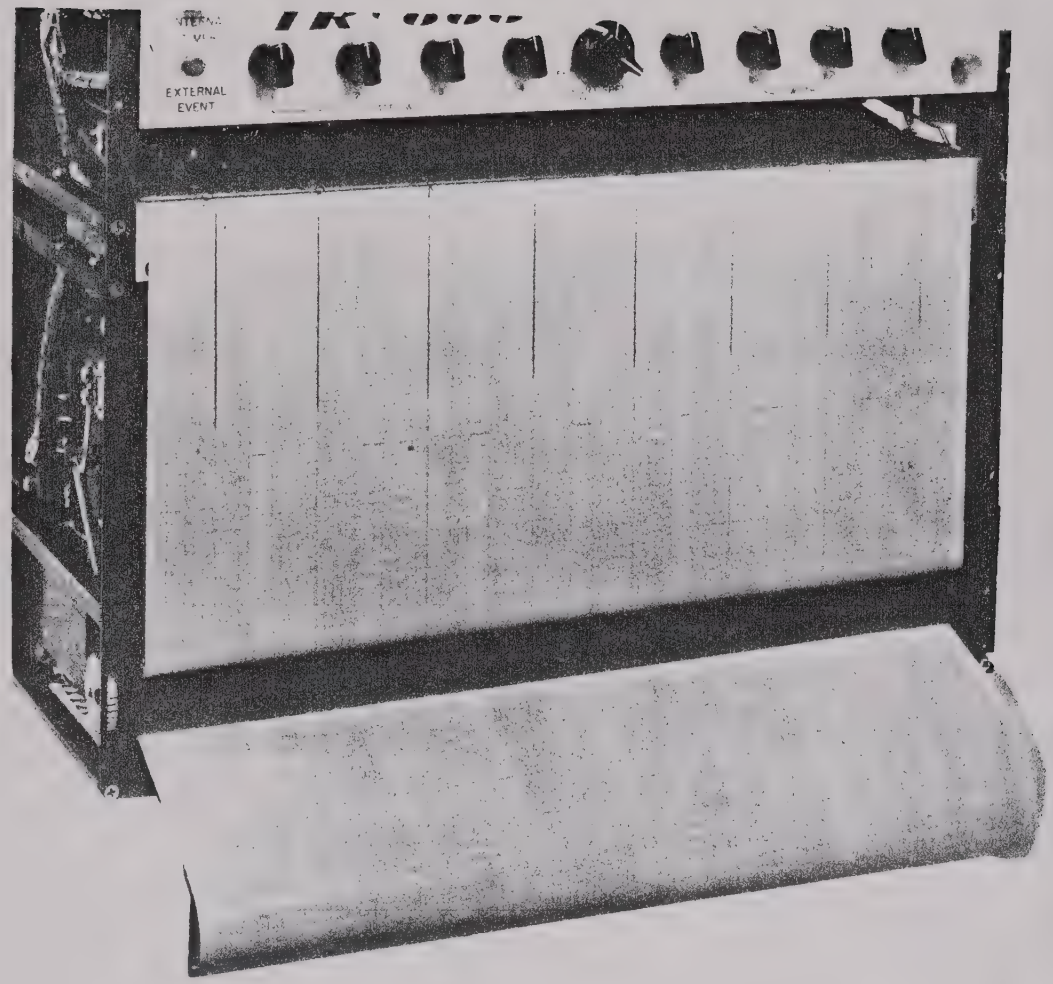


FIGURE 3-4. Chart loading completed,
Step 3

B. Calibration Schedule

1. IMPORTANT NOTE: The procedures that follow and time intervals specified have only to do with verification of internal calibration and writing system integrity. Calibration of the signal conditioners (according to their specific operating instructions) should be at more frequent intervals such as whenever a new roll of chart has been installed, or whenever a new module has been installed in a particular channel. These periods in some cases, could be a daily procedure.

a) A small white sticker is affixed to the back of the writing table. This is the original calibration date. It is suggested that the first system calibration be 30 to 60 days after the date stamped on the sticker.

b) Thereafter, calibration intervals should be as frequent as necessary based on the frequency of usage and the accuracy required of it. Generally, if 1% accuracy is required, then a calibration is necessary every 90 to 120 days.

2. Electro-Mechanical and Electronic Alignment Procedures

The following procedures should be followed carefully in the order given:

a) Carefully inspect the writing elements of all analog styli. Remove, discard, and replace those styli whose writing elements show signs of excessive wear, such as flattening or cracking at the welded joints. Signs of abuse or misuse, such as bent heaters and bent stylus struts are also cause for replacement and should be brought to the attention of the operator. See STYLUS ADJUSTMENT AND REPLACEMENT, Chapter V.

b) Remove signal conditioner modules. Apply line power to the recorder and run two to three feet of chart at approximately 5 mm/sec chart speed.

c) Read the chart: Traces should be within ±1 mm of their respective channel center lines. If not, they must be adjusted according to the instructions that follow. Otherwise, non-linearity will result.

d) Repeat steps b) and c) until all styli track within 1 mm of the center of their channels. Reinstall signal conditioner modules.

e) Check the writing pressure of each stylus as follows:

1) Chart must be moving at a slow speed (1 to 5 mm/sec) and trace width controls adjusted for a fine trace.

2) Place the blade of the pressure gage under the tip of the stylus heater and lift straight up. Read the gage just as the stylus leaves the chart (stops writing).

3) Stylus pressure should be in the range between 2 and 4 grams.

4) To adjust stylus pressure, carefully apply slight up or down finger pressure to each of the stylus struts at the rear of the stylus where the struts are attached to the stylus body. Pressure down will increase stylus pressure; pressure up will decrease stylus pressure.

f) SPECIAL NOTE: The Model TSC-5 carrier type signal conditioner (if used) needs only to be calibrated to be operating properly. The TSC-801, 810, 50 or 500 signal conditioners, however, need additional calibration checks. These are discussed in g) that follows.

g) Set up and calibrate each signal conditioner according to the manual instructions for that conditioner. Then insert a positive DC signal of 0.1% or 0.25% accuracy into the positive input of the signal conditioner. The amplitude of this signal is to be equal to 20 times the maximum sensitivity per chart division of that signal conditioner (20 mv for Model TSC-801; 200 mv for Model TSC-801; 200 mv for Model TSC-810). This accurate voltage

signal is best obtained by using the Monroe Model 205 precision voltage source (or equivalent) and monitoring its output with a precision voltmeter such as the Fluke 801H (or equivalent). To calibrate the signal conditioner, switch the RANGE switch to CAL. The stylus should deflect 20 divisions to the right. Then turn the RANGE switch to maximum sensitivity (for that conditioner) with the CHART SPEED at 5 or 10 mm/sec. Observe the deflections of the trace in both CAL and maximum sensitivity positions of the RANGE switch. They should coincide within 0.25 division to 0.5 division. If the two deflections do not agree, carefully check and recalibrate the signal conditioner giving special attention to properly setting POSITION and GAIN. If this does not cause deflections to agree, see PREVENTIVE MAINTENANCE, Chapter V, Setting The Cal Adjustment Potentiometer.

h) Check symmetry by reversing the polarity of the input signal; the stylus should deflect through zero to -20 divisions, i.e. should "mirror-image" within ½ chart division.

Example: +20 mv signal causes +20.5 chart divisions deflection; -20 mv signal should cause -20.5 divisions deflection, ±0.5 chart division. The capability of the average pen motor is far better than this and will usually yield symmetry of 0.25 division or better. See PREVENTIVE MAINTENANCE, Chapter V, if symmetry is "off".

i) Pen Motor Damping: With chart running at 5 to 10 mm/second, insert a one Hertz square wave signal into the input of the signal conditioner and adjust the signal generator and/or signal conditioner controls until the signal is recorded at an amplitude of 48 divisions peak-to-peak at a medium trace width. There should be 1/3 to 1 division overshoot of the stylus in its response to a one Hertz square wave of this amplitude. Note: The stylus heat (trace width) control will affect overshoot. It

is only necessary to verify that the specified amount of overshoot is present at a medium setting of the stylus heat (trace width) control. If insufficient overshoot is present, stylus pressure may be higher than 4 grams. Check and reset stylus pressure if necessary, then recheck overshoot. (See examples of overshoot and undershoot that follow.)

j) Checking Frequency Response: All frequency response tests and procedures that follow are only valid when run under conditions of sine wave signal input.

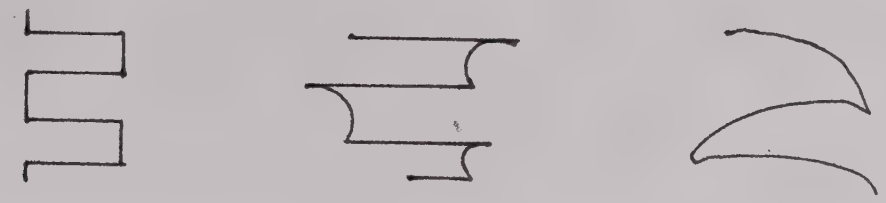
1) Gain-Bandwidth Product: The gain-bandwidth product of this recording system is roughly equivalent to the driving power available to the pen motor, and provides a way of judging the maximum peak-to-peak in-phase deflection of the stylus in response to a sine wave signal input.

2) The Gain-Bandwidth Product of the TR-888 is approximately 1000 Hz-mm. It is used as follows: Assume you want to find the maximum frequency to which the recorder will write at full scale (40 mm): Simply divide 1000 Hz-mm by 40 mm. The answer is 25 Hertz. This means that the recorder is capable of recording "flat" (within the practical limit of one db) from DC to 25 Hertz at 40 mm peak-to-peak. In the same way, the recorder will record, flat, DC to 50 Hertz at 20 mm peak-to-peak, or DC to 100 Hertz at 10 mm peak-to-peak.

3) Specific limits using the more usual "flat within 3 db" specification are shown in the Specifications (CHAPTER 1).

4) Switch the function generator and signal conditioner controls to center the signal trace in its channel; adjust trace width to the lowest point to obtain a dark grey trace at a chart speed of 0.5 or 1 mm/sec. Slowly increase signal frequency through the range of interest, while slowly increasing the trace width to maintain the same envelope color, and signal conditioner position control to maintain signal envelope at channel center.

5) Examples of Overshoot and Undershoot: The following are examples of overshoot and undershoot that are traced on the chart by the stylus:



GOOD TRACE OVERSHOOT UNDERSHOOT

If frequency response specifications cannot be met (DC to 125 Hz) then overshoot and undershoot must be considered. To correct overshoot and undershoot check for excessive stylus pressure (Chapter V) or adjustment of the pen motor damping. This latter adjustment necessitates the use of the pen motor alignment tool as shown in Figure 5-1. To adjust the pen motor follow the instructions "HOW TO ADJUST PEN MOTOR DAMPING", Chapter V.

k) Check Hysteresis: Set chart speed to 5 mm/sec. Starting with the stylus at channel center, insert sufficient positive signal to deflect the stylus full scale in either direction. This is done by moving the position control CW and CCW. Remove the signal and assure that the stylus returns to chart center within 0.25 division. If the stylus does not return to center then the following could be the reason for suspected trouble:

1) Defective pen motor.
2) Excessive stylus pressure.
3) Interference with the stylus lead.
4) Stylus is loose on the pen shaft.
5) Stylus body is rubbing on the pen motor. (Raise stylus on shaft so as not to rub on pen motor.)

IV. PRINCIPLES OF OPERATION

A. Pen Motor

The Techni-Rite pen motor is a velocity feedback galvanometric device. It is fully shielded. Its moving coil "sees" more than 90% of the magnetic field of the self-contained permanent magnet.

B. Pen Motor with Self-contained Integrated Driver Amplifier.

The pen motor/amplifier combination is supplied as a sealed, complete unit requiring only DC power and a signal voltage to become a recording system. The TR-888 recorder is equipped with eight of these units. Each pen motor/amplifier accepts plus and minus power (regulated ±15 VDC at 325 ma), a positioning voltage and a signal voltage, all as outputs from its associated signal conditioner. The basic sensitivity of the pen motor/amplifier in the TR-888 is 8 mv per chart division. Internally, the integrated driver amplifier supplies temperature and frequency compensated driving power to the pen motor drive coil and accepts velocity signals (proportional to the rotational velocity of the pen motor shaft) from the velocity winding of the pen motor, to ensure input/output phase relationship. A signal control, mounted on the top cap of the pen motor/amplifier, adjusts system damping over a wide range from underdamped to overdamped.

C. Basic Recorder

This section discusses chart speed and stylus heat control circuitry.

1. Chart Speed: The TR-888 recorder is equipped with a two speed hysteresis - synchronous drive motor and a four-speed electrically selected transmission. There are 8 speeds from 0.5 to 10 mm/second. The various combinations of chart drive motor speeds and transmission ratios are selected by decks of the chart speed switch (S2) shown in the table that follows. (See Dwg. 600768 in Chapter VIII.)

CHART SPEED mm/sec	DRIVE MOTOR RPM	TRANSMISSION RATIOS ENGAGED
0.5	900	5:1 & 20:1
1.0	1800	5:1 & 20:1
2.5	900	20:1
5.0	1800	20:1
10	900	5:1
20	1800	5:1
50	900	NONE
100	1800	NONE

Note on drawing 600768 that the relay controls (K1) drive the motor speed switching. K1 removes the heavy inductive load of the drive motor from the chart speed switch and prevents radiation of the inductive motor switching surge within and outside the recorder by keeping the motor power leads short. With the transmission the AC voltage, fed to the speed-change clutch actuator coils, is rectified by bridge rectifiers which are an integral sealed component of the transmission. In addition, each coil has a backward connected single diode which conducts only when a sudden disconnection of power (such as speed change) produces a sudden surge of reverse voltage. This prevents the reverse EMF surge from interfering with the operation of other adjacent equipments.

2. Stylus Heat Control Circuitry (See drawing 600768.)

The one remaining deck of the chart speed control (S2e), switches the primary taps of transformer T9 in such a manner that an increasing stylus power voltage appears at the 9 separate secondary windings of the transformer with each increase in chart speed above 2.5 mm/sec. Thus, the trace on the chart will remain reasonably constant for all chart speeds. In addition, a separate potentiometer control is included for each stylus to give an additional 10:1 stylus power adjustment to adjust each stylus according to the particular characteristics of the recording signal.

V. PREVENTIVE MAINTENANCE AND PARTS REPLACEMENT

A. PREVENTIVE MAINTENANCE

1. LIST OF TEST EQUIPMENT REQUIRED:

The following test and alignment equipment should be available for the most efficient performance of the maintenance procedures that follow:

1. Recorder Accessory Maintenance Tool Kit (supplied with each recorder).
   a) Stylus installation tool, and,
   b) Pen motor damping alignment tool
2. Signal Generator
   a) Hewlett Packard
      Model 202A, or
   b) Wave-Tek
      Model 110,
3. Precision Voltage Source
   a) Monroe Electronic Laboratories
      Model 205 (or equal)
4. Precision DC Voltmeter
   a) Fluke Model 801H, or
   b) A good quality
      digital voltmeter of 3 1/2 digit or 4 digit capability.
5. Volt-ohmmeter
   a) Simpson Model 260, or
   b) Triplett Model 530
6. Tools
   a) Standard set of Allen wrenches, ranging from #2 to 3/16"
   b) Stylus gage, Model TAC-129
   c) Extender Card or Cable model TAC-130
   d) Phillips screwdriver
   e) Straight-blade screwdriver
   f) Needle-nose pliers.

7. Lubricants

a) Small can SAE 10 lubricating oil (or any common "household" lubricant which is not of the penetrating variety).

b) Small container of Esso "beacon" grease or any light grease which has a wide temperature range and a low oxidation rate. Silicon grease is excellent for this application. Virtually any silicon grease which meets the above criteria will do. Note: Cotton Swabs make excellent applicators for grease.

2. Mechanical Maintenance Schedule and Lubrication Points:

Extensive use has been made in this recorder of sealed ball bearings lubricated for life, a period estimated to be 5000 to 8000 hours in normal operation. Replacement of all ball bearings requires only one hour. Other areas requiring lubrication include:

a. Apply a light film of grease to the following surfaces after every 200 operating hours.

1. Stylus lifter cam surface
2. Chart mandrel mounts
3. Chart drive chain (located under right-hand cover plate).

b. Apply two drops of oil to each of the four shafts extending through the end plates of the transmission after every 500 operating hours, or every 6 months. (Remove right-hand cover plate and bottom cover plate for access).

c. If recorder is mounted in a vehicle or on a ship, check the following bolts for tightness every 200 operating hours.

1. Pen motor mounting screws (access through (16) holes punched in base plate, from rear of recorder).

2. Pen motor mounting strut screws (remove right and lefthand cover plates for access - total 4 screws).

3. How To Compensate For Non-Symmetry.

a. Occasionally, a stylus which has been accurately set at channel center will not exhibit good symmetry. This might be due to the geometry of the stylus if its heater is not parallel to the axis. In a small percentage of these cases, the per motor itself may contribute to the error due to production variations within the pen motor, or in its mounting.

b. First, assure that the pen motor mounting screws are tight (using Allen wrench through access holes at rear of baseplate).

c. If this approach does not rectify the problem, and the pen motor -stylus system will still not meet the symmetry criteria in this chapter, do not attempt to bend the stylus struts.

d. Simply determine the extent and direction of the non-symmetry and reset the mechanical zero of the stylus in the direction of the deficiency.

EXAMPLE: With stylus mechanical zero set at +1/2 mm, a positive full-scale signal is adjusted to give a +25 chart line deflection. The same signal of reversed polarity produces only -24 chart lines deflection. Reset mechanical zero according to instructions in this chapter so that the stylus tracks at - 1/2 mm. Reset position and gain control and retest.

4. How to Adjust Pen Motor Damping:

a. Set up and calibrate the recorder as outlined in PREVENTIVE MAINTENANCE, capter V.

b. There are eight access holes in the top cover plate of the recorder; insert the damping alignment tool (figure 5-1) through the recorder hole located directly above the channel which must be adjusted. Aim the tool at approximately a 5 degree angle towards the recorder baseplate so that it will pass through its alignment hole located in line between the access hole and the damping adjustment control, which is located in the rear corner of the pen motor top cap on the right side.

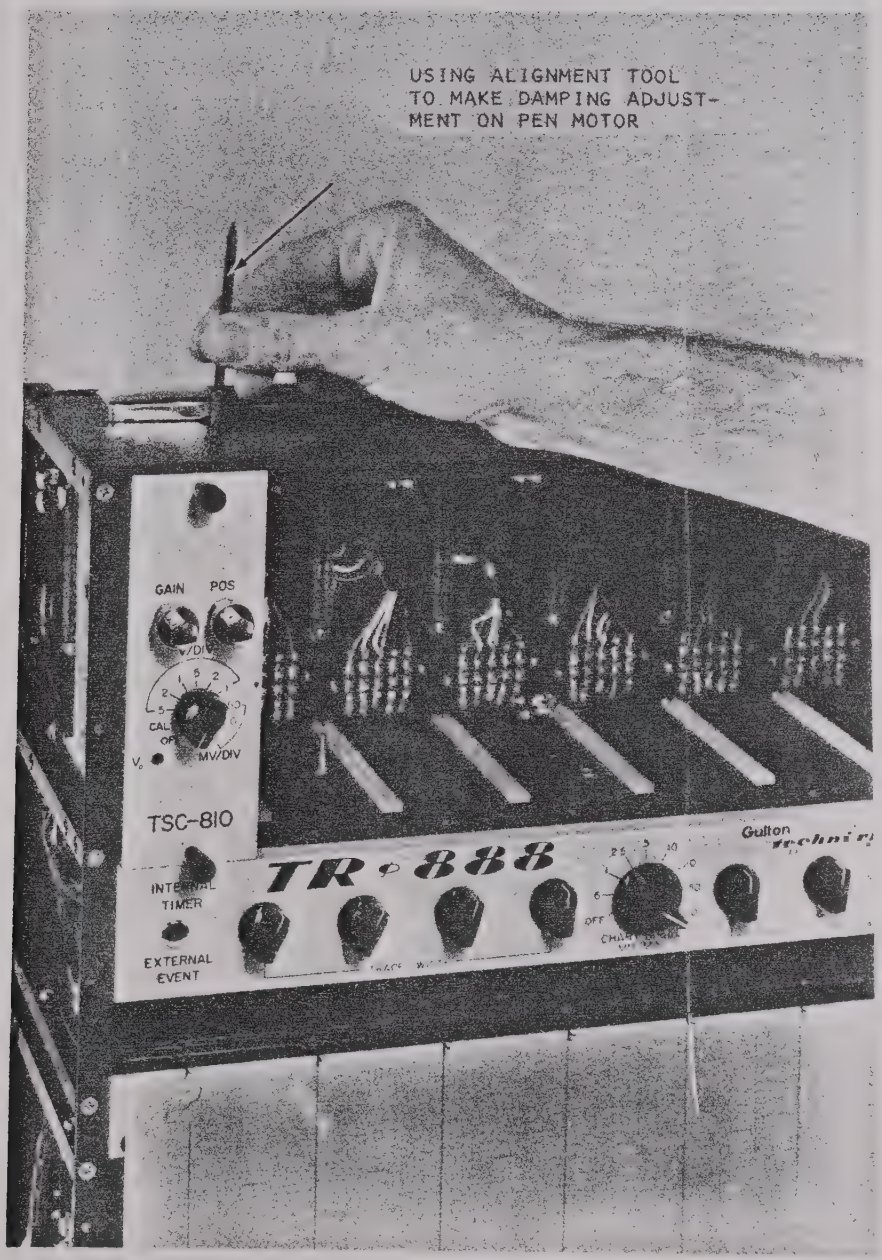


FIGURE 5-1. Pen motor damping adjustment

c. During initial adjustments, it is helpful to temporarily remove the signal conditioner to locate the alignment hole.

d. After is has been removed sight over the edge of the writing table and rotate the damping alignment tool until it seats in the slot of the pen motor damping control.

e. Carefully turn the damping fully CW then CCW approximately 1/8 turn for an approximate setting; then with 1 HZ 48 mm peak-to-peak amplitude square wave signal applied, slowly adjust the damping control to meet the criteria in Chapter III, OPeration and Calibration.

f. Never seal the damping control. The control would then have to be replaced at the factory if readjustment became necessary.

5. How to Adjust Stylus Limiters (Stops built into Pen Motor)

If pen motor stops ("A" and "B") are unsealed as supplied, they must be set and sealed before unit is placed into service. Proceed as follows: (see sketch on next page)

a. Using a 0.125" hex nut driver, (X-celite model P-4 or equal) turn stop "A" CCW and stop "B" CW until resistance is felt.

b. Install unit electrically, load chart drive with chart and run several feet of chart to assure that its position has stabilized in the drive assembly.

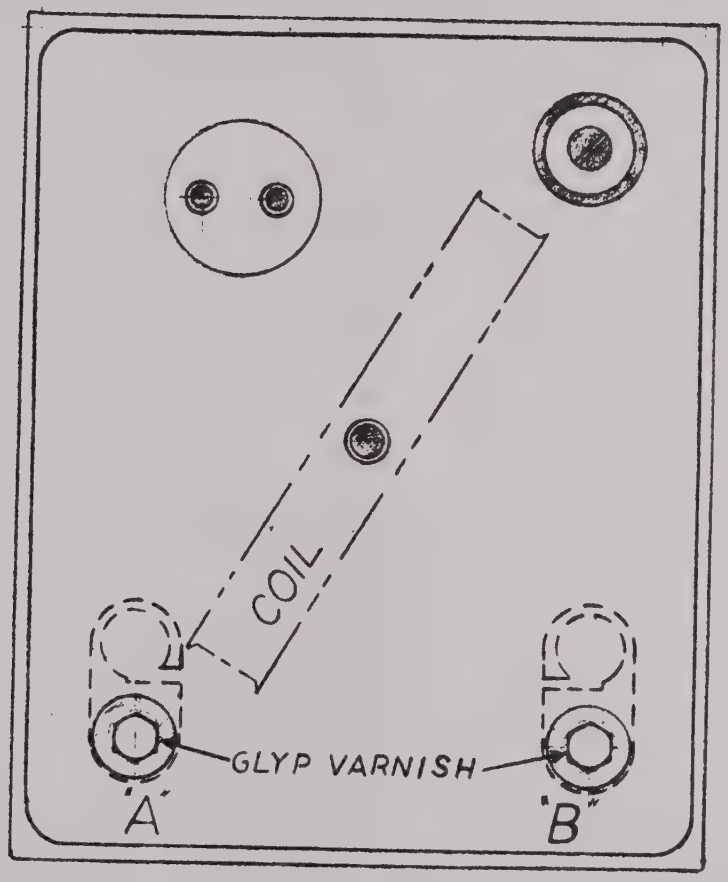
c. Electrically position the stylus left to a point 3 mm outside the channel margin. Slowly turn stop "A" CW until the stylus is seen to move toward channel center a distance of ½ mm.

d. Electrically position the stylus right to a point 3 mm outside the channel margin. Slowly turn stop "B" CCW until the stylus is seen to move toward channel center a distance of ½ mm.

e. NOTE: Special circumstances, such as the installation of an event marker, may require a finer secondary adjustment of the appropriate stop after a "trial run" of the unit.

f. NOTE: Under no circumstances may either stop be rotated through an angle greater than 90 degrees from its fully open position as defined in step a. This might result in damage to the pen motor and should be avoided.

g. After adjustment of the stops, apply glyp varnish to the areas shown.



TOP VIEW

6. Setting the CAL Adjustment Potentiometer of the Signal Conditioner:

Setting the CAL adjustment potentiometer may be done in 2 ways.

Procedure 1:

Set the signal conditioner RANGE switch to CAL and place the unit on an extender board (card) so that the CAL adjustment potentiometer may be adjusted. This may be accomplished by turning the small screw on the CAL adjustment potentiometer located at the rear of the PC board. The screwdriver adjustment is made from the bottom of the PC board. Turn the screw until the CAL voltage is set to read 20 times the maximum sensitivity per chart division of the signal conditioner, plus or minus 1%. For example: The TSC-810 signal conditioner has a maximum sensitivity of 10 mv/div; set CAL potentiometer for 20 x 10 or 200 mv ± 2 mv calibration signal. Note that if the recorder is being used in an environment which has considerable vibration, seal this control with glyptal varnish. Other applications do not require this control to be sealed.

Procedure 2:

Set the signal conditioner to the CAL position on the RANGE switch. This is important since the calibration voltage must be set in the loaded condition. With reference to the PC board connect a precision voltmeter (Fluke 801H or equivalent) between the non-inverting signal input test point and PC board common (or signal input common) test point. The calibration voltage should be set to read 20 times the maximum sensitivity per chart division of the signal conditioner, ± 1%. For example: The TSC-810 signal conditioner has a maximum sensitivity of 10 mv/div; set CAL potentiometer for 20 x 10 or 200 mv ± 2 mv calibration signal. Note that if the recorder is being used in an environment which has considerable vibration, seal this control with glyptal varnish. Other applications do not require this control to be sealed.

B. Parts Replacement

1. Stylus Replacement

a. When the stylus ceases to operate due to a broken or bent writing element, it must be replaced. Leave the chart paper in the recorder.

b. SHUT RECORDER POWER OFF. (See sketch A when performing Instructions a. through g.

c. Locate the defective stylus; remove the stylus power plug from its socket. Loosen the stylus clamping screw located on the stylus body. Lift the stylus from the pen motor shaft and discard.

d. To install the stylus fit it over the pen motor shaft leaving at least 1/32" clearance between stylus body and pen motor cap. Position the stylus within one chart line (either right or left) of the center line of its channel and then tighten the screw.

e. Insert stylus power plug into its socket. Start recorder running.

f. Correct stylus pressure is important not only during replacement but it should also be checked periodically. Always check pressure with recorder running and noticeable trace on chart. Using a stylus pressure gage, hook the stylus gage blade under the stylus writing element and lift directly away at right angles to the stylus. (Be sure stylus is not stuck to the chart.)* Read the stylus gage just as the writing element lifts away from the chart. The pressure at this instant should be 2 to 5 grams or at whatever pressure the stylus writes better for a specific application. If the pressure is too low, improper writing at high speeds will result. If pressure is too high, recorder rise time (response) will be slow and/or stylus life will be shortened.

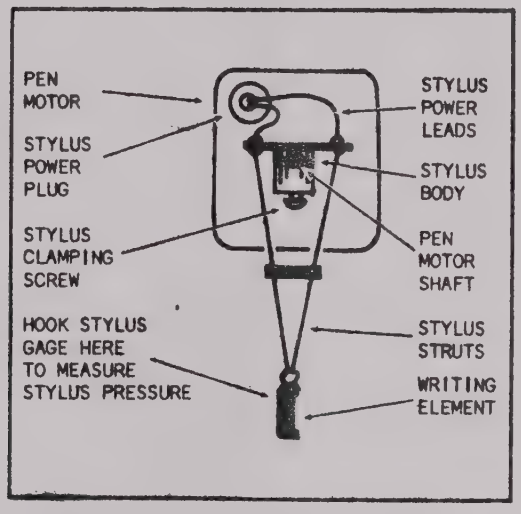
To correct improper stylus pressure perform (1) or (2) below: (1) STOP RECORDER. Carefully bend the rear quarter stylus struts in the following manner: Hold the rear of the stylus body firmly in your left hand with the writing element towards you. With your right

*After extended use, a plastic chart coating may build up on the writing element causing uneven writing. With the heat up high and the recorder stopped, the stylus heater will stock to the chart. To clean the writing element, carefully scrape it with a razor blade.

hand bend the front 2/3 of the stylus struts slightly downward if the pressure is too low or upward if the pressure is too high. Recheck stylus position on chart and correct if necessary.
(2) Loosen the stylus clamping screw and slide the stylus up (to lower pressure) or down (to increase pressure) on the pen motor shaft. Be careful stylus does not touch pen motor. (Recheck stylus pressure on chart.)

g. The recorder is now ready for operation.

TYPICAL TECHNI-RITE STYLUS



SKETCH A

2. Fuse Replacement

Fuse location: The nine twist-type fuse holders are located on the rear panel of the recorder. The main power fuse, F1, is located next to the power cord connector, and the individual analog channel fuses, F2 through F9, are located in a horizontal line directly behind the chart magazine.

Fuse No.	Replace Only With
F1	6 ampere fast-blow type (3AG)
F2 thru F9	¼ ampere slow-blow type (MDL-¼)

3. Pen Motor Replacement

Each pen motor can be removed and replaced simply. Two (2) screws, holding each pen motor, are located in the rear of the recorder. Holes in the rear of the recorder, located about half-way, permit easy screw removal. Next, remove the pen motor wires from the terminal strip for the particular pen motor being removed. The pen motor is now free to be removed and can be removed through the area occupied by the chart paper. The chart paper, therefore, must be removed first.

To replace the pen motor perform the reverse procedure.

VI. TROUBLE-SHOOTING

	SYMPTOM	POSSIBLE TROUBLE	TO CORRECT (See Dwg. 600900 Pg. 1,2,3 for part locations Ref. Des. in ( ))
1.	NO POWER TO RECORDER	a) Blown main fuse. b) Power cable disconnected.	a) Replace with proper fuse (69). See fuse replacement, chapter V. b) Connect power cable (54).
2.	NO STYLUS DEFLECTION	a) No power to signal conditioner or channel. (fuse or transformer) b) Pen motor defective. c) Defective signal conditioner.	a) Check fuse and recorder transformer (57). b) Replace pen motor (76). See pen motor replacement, chapter V. c) Replace signal conditioner.
3.	CHART SPEED WON'T ACTUATE OR IS INTERMITTENT.	a) Drive chain loose or broken. b) Control knob loose.	a) Tighten chain (51) or replace if broken. b) Tighten control knob on shaft.
4.	TRACE WIDTH WON'T CHANGE OR NO TRACE	a) Loose control knob. b) Heater transformer faulty. c) Broken stylus. d) Defective pen motor.	a) Tighten control knob on shaft. b) Replace heater transformer (50). See chapter V. c) Replace stylus. See stylus replacement. d) Replace pen motor. See pen motor replacement, chapter V.
5.	NOISE ON TRACE	a) Poor frame ground. b) Unshielded signal leads. c) Defective recorder transformer. d) Defective signal conditioner.	a) Establish good ground. b) Shield signal leads external to recorder. c) Check transformer voltages. See schematic dwg. 600768. d) Replace signal conditioner.

	SYMPTOM	POSSIBLE TROUBLE	TO CORRECT
6.	POOR LINEARITY; EXCESSIVE HYSTERESIS	a) Loose stylus, broken stylus. b) Stylus stop set for less than 2 mm from channel edge. c) Excessive stylus pressure. d) Stylus installed so that power leads interfere with recorder frame.	a) Tighten or replace stylus. See Stylus Replacement, Chapter V. b) Set mechanical stops. See pen motor adjustments. c) Adjust stylus pressure to application. d) Install stylus correctly. See Stylus Replacement, Chapter V.
7.	STYLUS POSITIONING & OPERATION ON ONE SIDE OF CHART CENTER ONLY	a) Signal conditioner defective. b) Pen motor defective.	a) See conditioner manual. See Chapter I footnote for proper manual. b) Replace pen motor. See Pen Motor Replacement, Chapter V.
8.	INSUFFICIENT STYLUS HEAT; INSUFFICIENT TRACE WIDTH; POOR TRACE AT HIGHER FREQUENCIES	a) Stylus power plug loose or has poor contact in socket. b) Oxidation on heat potentiometer gives poor contact; defective potentiometer (49). c) Defective stylus gives intermittent trace. d) Stylus pressure too light for application.	a) Correct both conditions or replace stylus See Stylus Replacement, Chapter V. b) Replace potentiometer. c) Replace stylus. See Stylus Replacement Chapter V. d) Increase stylus pressure to where it will write properly for application.
9.	CHART DRIFTS	a) Chart load mandrel not properly in place or locked in place; chart roll not secured on mandrel. b) Not using T/R recommended paper.	a) Check to be sure paper (68) and mandrel are properly installed. Be sure end of mandrel is screwed on snug. b) Only use T/R recommended paper.
10.	ADJUSTMENT FOR DAMPING HAS LITTLE OR NO EFFECT	a) Pen motor defective. b) Incorrect stylus pressure for application.	a) Replace pen motor. See Pen Motor Replacement, Chapter V. b) Use correct stylus pressure for application. See Stylus Replacement and Adjustment, Chapter V.

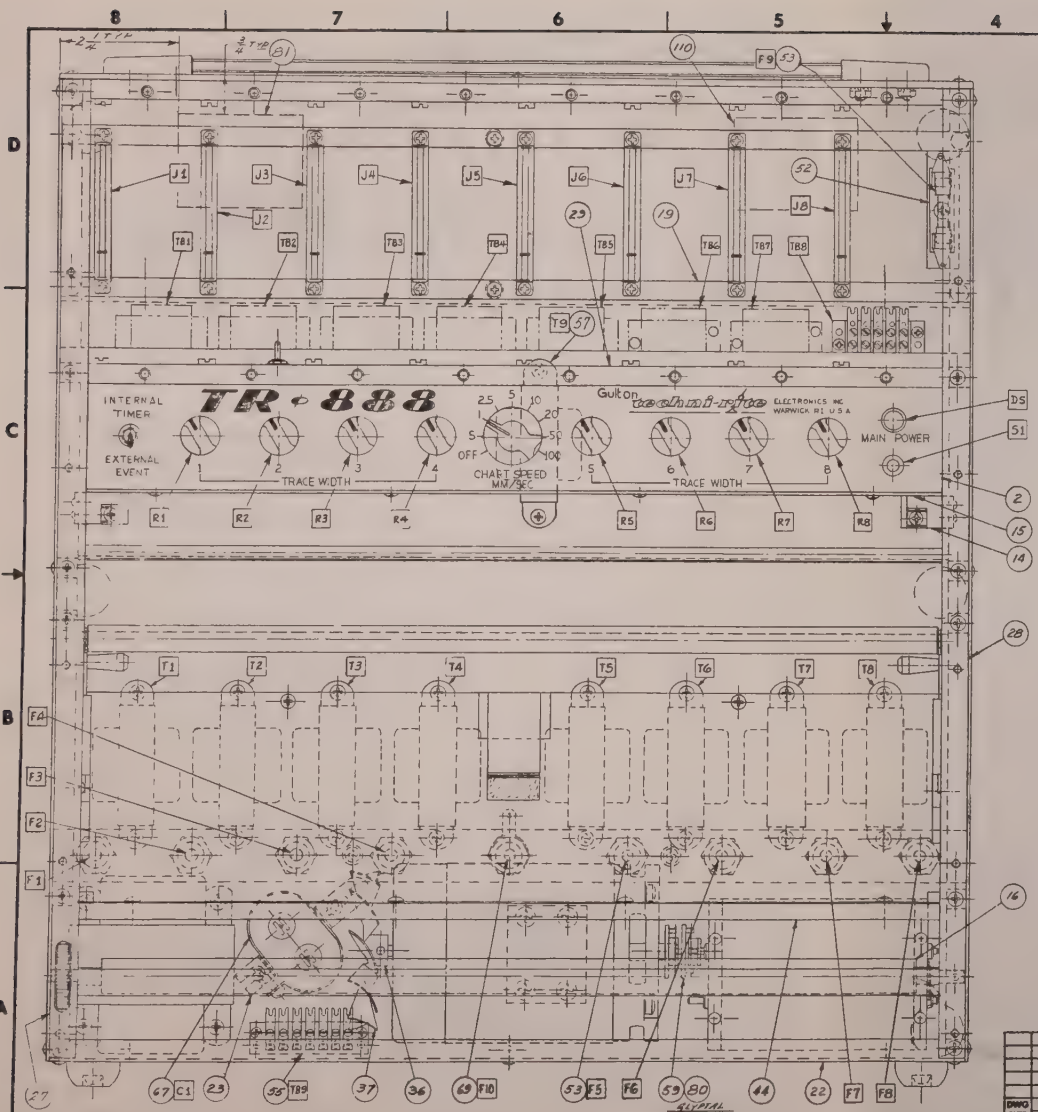
VII. PARTS LIST

Ref. Des.	DWG. 600900 Pg. 1, 2, 3 Description	Techni-Rite Part Number	Units per Ass'y
1	Ass'y, Writing Table	600903	1
2	Ass'y, Control Panel	401255	1
3	Ass'y, Fuse Holder	401281	1
4	Ass'y, Connector Strip RH	201506	1
5	Ass'y, Connector Strip LH	201505	1
6	Ass'y, Rear Panel	401235	1
7	Ass'y, Spool Bracket RH	201831	1
8	Ass'y, Spool Bracket LH	201832	1
9	Ass'y, Idler Roll	201270	1
10	Ass'y, Bottom PC board Holder	401250	1
11	Ass'y, Top PC board Holder	401249	1
12	Ass'y, Roll Snubber	201568	1
13	Ass'y, Paper Drag	201268	1
14	Ass'y, Clip Lock Bracket RH &LH	201518	2
15	Ass'y, Heat Plug-in Plate	401253	1
16	Roll, Drive	1-201515	1
17	Ass'y, Paper Roll Mandrel	600962	1
18	Ass'y, Event Marker RH TAC-120	201296	1
19	Ass'y, Connector Strut	401186	1
20	Ass'y, Adjustable Bracket	106025	1
21	Transmission, 4-Speed	600781	1
22	Ass'y, Front Panel	401256	1
23	Ass'y, Clamp Capacitor	104997-3	1
24	Stylus, Heat	SA-88	8
25	Bearing, Ball	201637-13	2
26	Gear, Spur (Drive Roll)	105071	1
27	Frame, Left Side	401192	1
28	Frame, Right Side	401191	1
29	Strut, Module Locator	401195	2
30	Base, Plate	600811	1
31	Sprocket, 10T Transmission	2-103769-10	1
32	Sprocket, 20T Drive Roll	20-103769-20	1
33	Nut, Hex	105109	1
34	Strut, Front Panel	105158	1
35	Strut, Rear Panel	105157	1
36	Blower, Adapter	105076	1
37	Blower, Drive Motor	105073	1
38	Insulator	106022	1
39	Spacer, Motor	105050	1
40	Stylus, Lifter	201264	1
41	Panel, LH Side	401247	1
42	Panel, RH Side	401182	1
43	Shield, Transformer	401198	1
44	Spacer, Shield Strut	401193	1
45	Shield, Paper	401293	1
46	Spacer, Front	401215	1

Ref. Des.	DWG. 600900 Pg. 1, 2, 3 Description	Techni-Rite Part Number	Units per Ass'y
47	Motor, 900 & 1800 RPM	401145	1
48	Spring, Round Wire	100175	2
49	Potentiometer	100745	1
50	Analog Heater Transformer	101690	1
51	Chain, Micropitch	101845-10¾	1
52	Holder, Fuse	102077	1
53	Fuses, Slo-Blow	102200-¼	9
54	Cable, Power (Not Shown)	102368	1
55	Terminal Board	102595-7	1
56	Not Used		
57	Transformer, Power	104489	9
58	Strut (Spacer) Blank	104618-2	2
59	Coupling, Flexible	104723	1
60	Strut, Spacer #2	104906	2
61	Strut, Spacer #3	104907	2
62	Strut, Spacer #1 LH	104909-3	1
63	Strut, Spacer #1 RH	104909-2	1
64	Strut, PC board #4	104912	2
65	Strut, Rear Panel #5 RH	104926	1
66	Strut, Rear Panel #6 LH	104927	1
67	Capacitor, Motor	105051	1
68	Chute, Paper	105056-2	1
69	Fuses, Slo-Blow	102200-6¾	1
70	Standoff	106014-2	2
71	Spacer, Fuse Holder	106034	4
72	NOt used		
73	Not used		
74	Strut, Pen Motor	401237	1
75	Washer	105143	4
76	Amplifier, Pen Motor(TM15/10)	600627	8
77	Rubber Bumper & Washer	100301	6
78	Strut	401627	1
79	Tool Kit (Not Shown)	500468	1
80	Screw Socket Set (Bristol)	#4-40 x 1/8	4
81	Name plate	101434	1
82	Connector (Male)	201141-2	1
83	Connector (Female)	201127-2	8
84	Chain Connector	101422	1
85	Assembly, Filter	106628	1
86	Not Used		
87	Not Used		
88	Not Used		
89	Not Used		
90	Telephone Plug	103078	x
91	Schematic, Recorder	600768	x
92	Paper, Chart	BA-611	x
93	TAC 120 Event Marker LH	201296	x

Ref. Des.	DWG. 600900 Pg. 1, 2, 3 Description	Techni-Rite Part Number	Units per Ass'y
94	TAC-121 Rewinder	401294	x
95	TAC-122 Rack Mounting Panel	500437	x
96	TAC-124 Starter Kit	500510	x
97	TAC-125 One Second Timer	500530	x
98	TAC-127 Carrying Case (Leather)	600814	x
99	TAC-129 Stylus Gage	500455	x
100	TAC-130 Extender Card	401303	x
101	TSC-5 Assembly Module	401202	x
102	TSC-50 Assembly Module	401536	x
103	TSC-510 Assembly Module	401295	x
104	TSC-801 Assembly Module	401133	x
105	TSC-810 Assembly Module	401134	x
106	Rubber Bumper 2¾" lg.	105140	x
107	TAC-148 Assembly Panel Blank	401564	x
108	TSC-500 Assembly Module	401537	x
109	Control Dimmer	106230-2	x
110	Name plate	106146-X	x
111	Paper Guide	106341	3

VIII. SCHEMATICS AND DRAWINGS



DWG SIZE	CODE IDENT	SPECIFICATIONS	QUAN REQ	FIND NO.	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
		PARTS LIST				

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES.
TOLERANCES ON:
FRACTIONS ± 1/64 | TWO PLACE DECIMALS ± .010
ANGLES ± 1° | THREE PLACE DECIMALS ± .005
REMOVE ALL BURRS AND SHARP EDGES.
DIMENSIONS AND TOLERANCES SHALL BE HELD AFTER PLATING &2.
MACHINE SURFACES TO BE 125 RMS.
MATERIAL

DRAWN BY: J.M. PLOWMAN DATE
CHECKED BY: BER-MEL
CONTRACTOR CERTIFICATION:
DESIGN APPROVAL:
DOCUMENTATION APPROVAL:

Guiton techni-rite ELECTRONICS INCORPORATED

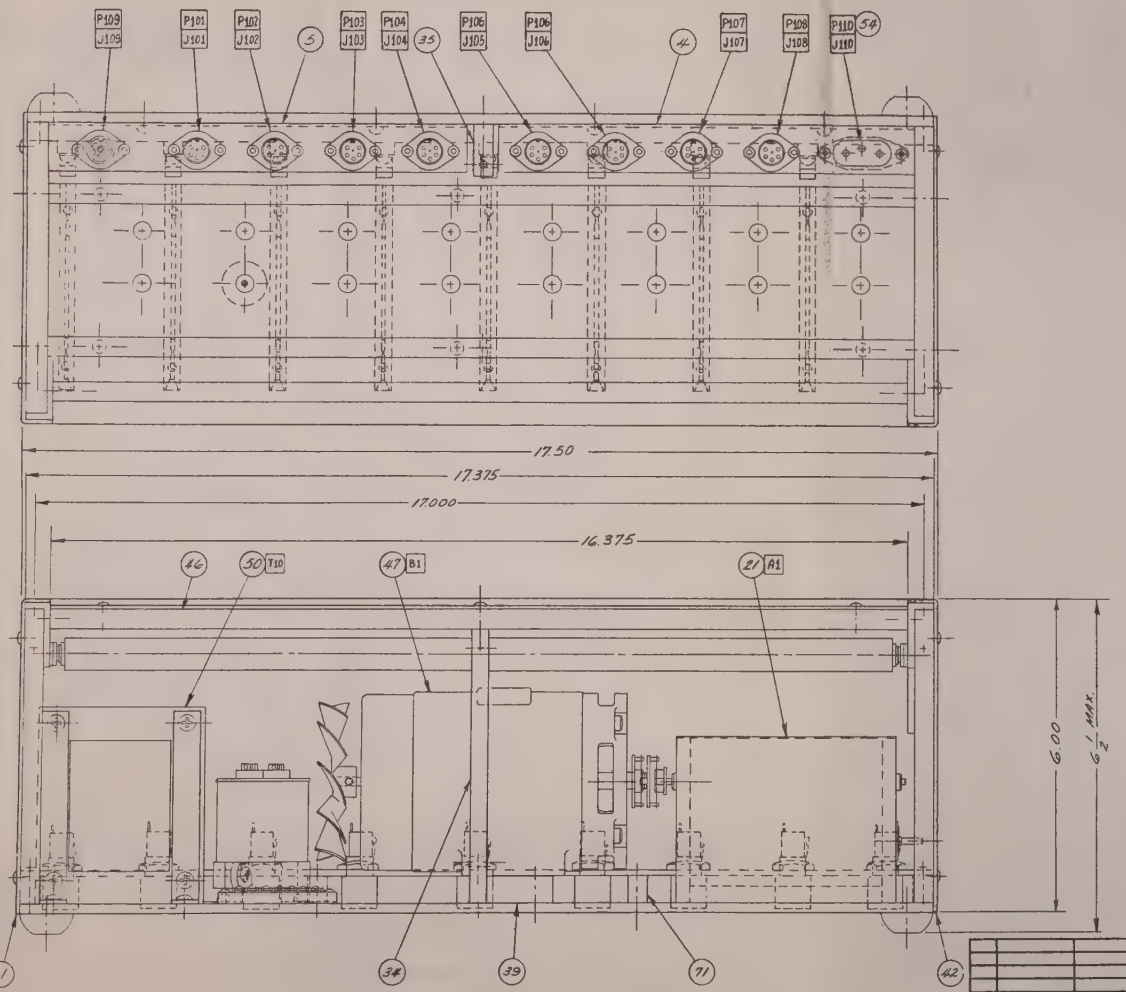
ASSY, RECORDER TR883

SIZE	CODE IDENT	DWG NO.
D		600900

SCALE	CONTRACT NO.	SHEET
1-1		1 OF 3

DWG SIZE	NEXT ASSY	USED ON
	APPLICATION	

600900



REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	REDRAWN	5 JAN 70	
	C	UP-DATED	3-10-70	20991

D 600900

DWG SIZE	CODE IDENT	SPECIFICATIONS	QUAN REQ	FIND NO.	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
		PARTS LIST				

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS ± 1/64
TWO PLACE DECIMALS ± .010
ANGLES ± 1°
THREE PLACE DECIMALS ± .005
REMOVE ALL BURRS AND SHARP EDGES
DIMENSIONS AND TOLERANCES SHALL BE HELD AFTER PLATING
63 MACHINE SURFACES TO BE ▽ SMS.
MATERIAL

DRAWN BY: DATE — DN FLOWMAN 15OCT69
CHECKED BY: BER-MEL
CONTRACTOR CERTIFICATION:
DESIGN APPROVAL:
DOCUMENTATION APPROVAL:

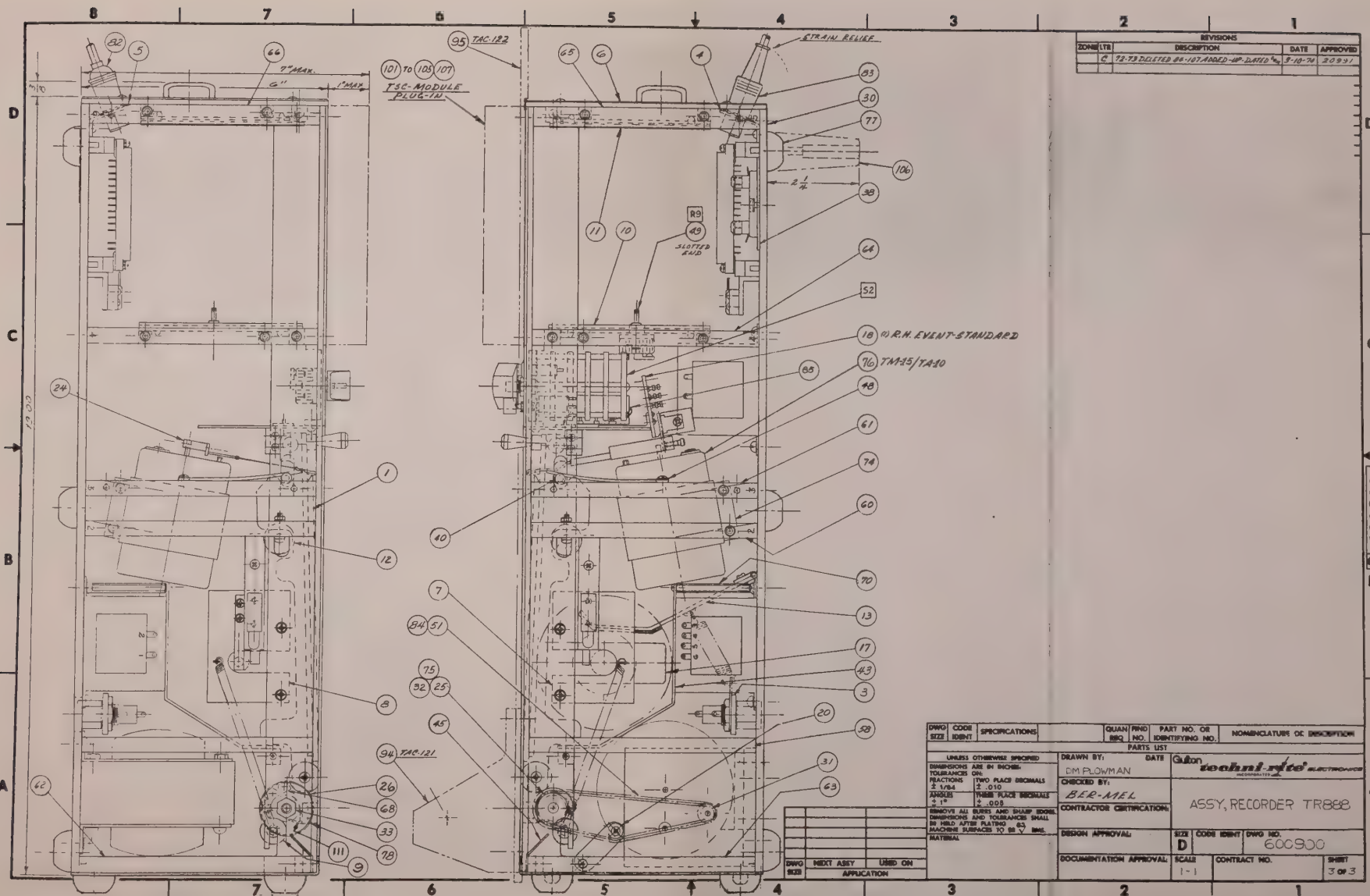
Gulton technI-rite ELECTRONICS

ASSY, RECORDER TR888

SIZE	CODE IDENT	DWG NO.
D		600900

SCALE 1-1 | CONTRACT NO. | SHEET 2 OF 3

DWG SIZE	NEXT ASSY	USED ON
		APPLICATION



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ZONE	LTR	DESCRIPTION	DATE	APPROVED
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DWG SIZE	CODE IDENT	SPECIFICATIONS	QUAN REQ	FIND NO.	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
		PARTS LIST				

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ± 1/64
TWO PLACE DECIMALS ± .010
ANGLES ± 1°
THREE PLACE DECIMALS ± .005
REMOVE ALL BURRS AND SHARP EDGES
DIMENSIONS AND TOLERANCES SHALL BE HELD AFTER PLATING
MACHINE SURFACES TO 63 √ RMS.
MATERIAL

DWG SIZE	NEXT ASSY	USED ON
	APPLICATION	

DRAWN BY: DM PLOWMAN DATE
CHECKED BY: BER-MEL
CONTRACTOR CERTIFICATION:
DESIGN APPROVAL:
DOCUMENTATION APPROVAL:

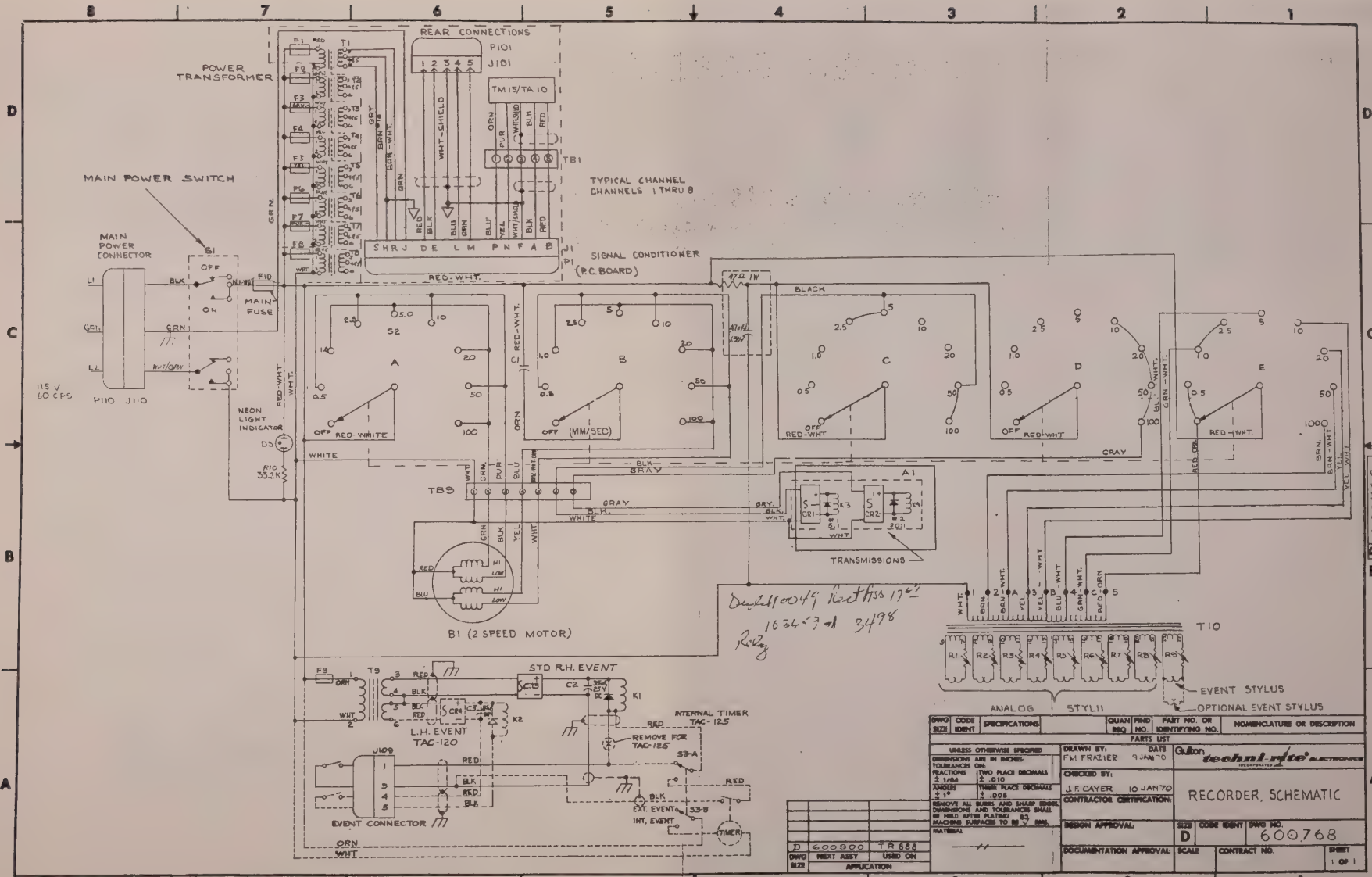
Calton technitrite ELECTRONICS INCORPORATED

ASSY, RECORDER TR888

SIZE	CODE IDENT	DWG NO.
D		600900

SCALE	CONTRACT NO.	SHEET
1-1		3 OF 3

D 600900



DWG SIZE	CODE IDENT	SPECIFICATIONS	QUAN REQ	FIND NO.	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
		PARTS LIST				

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ± 1/64
TWO PLACE DECIMALS ± .010
ANGLES ± 1°
THREE PLACE DECIMALS ± .005
REMOVE ALL BURRS AND SHARP EDGES
DIMENSIONS AND TOLERANCES SHALL BE HELD AFTER PLATING & MACHINING SURFACES TO BE ▽
MATERIAL

DRAWN BY: FM FRAZIER DATE 9 JAN 70
CHECKED BY: J.R CAYER 10 JAN 70
CONTRACTOR CERTIFICATION:
DESIGN APPROVAL:
DOCUMENTATION APPROVAL:

Gulton tech-rite ELECTRONICS INCORPORATED

RECORDER, SCHEMATIC

SIZE D | CODE IDENT | DWG NO. 600768
SCALE | CONTRACT NO. | SHEET 1 OF 1

D	600900	TR 868
DWG SIZE	NEXT ASSY	USED ON APPLICATION

D 600768

IX. ACCESSORIES

The following options and accessories are available:

1. Left hand event marker, Model TAC-120.
2. Chart rewinder, Model TAC-121.
3. Rack Adapter kit, Model TAC-122 (Figure 9-4).
4. One second timer, Model TAC-125.
5. Customer leather protective case, Model TAC-127 (Figure 9-3).
6. Special starter kit, Model TAC-143.
7. Carrying cart,* Model TAC-165 (Figures 9-1 and 9-2).

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* Portable and foldable lightweight cart made of aluminum with rubber wheel; holds up to 150 lbs. When folded for storage it is 24" high by 6" deep.

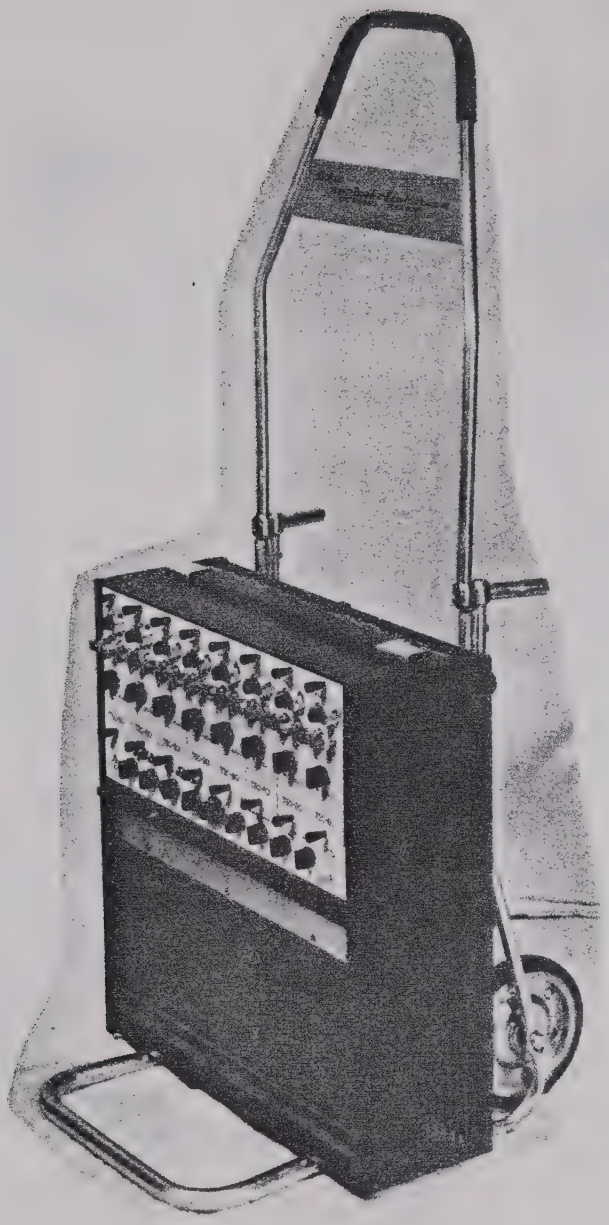


FIGURE 9-1. Carrying cart with Model TR888 Recorder

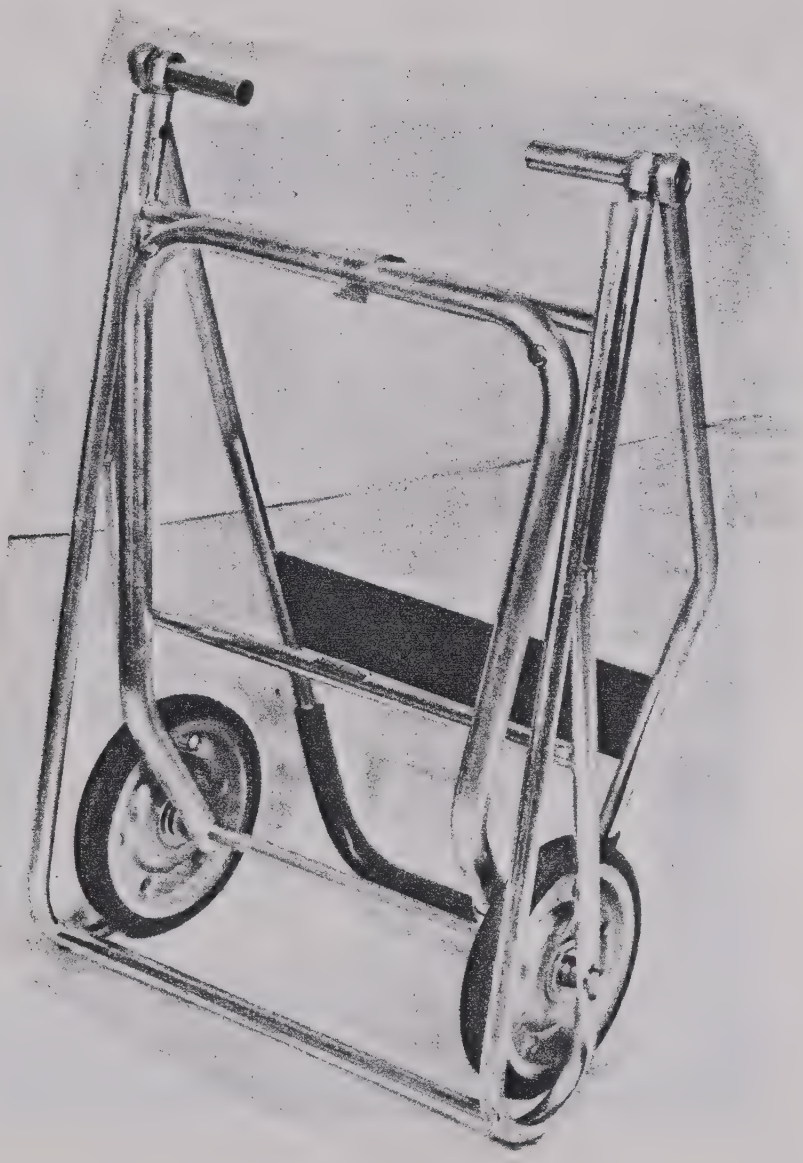


FIGURE 9-2. Carrying cart folded and ready for storage

L-359A

FIGURE 9-3. Recorder carrying case with chart paper roll

L-359A

TAC-122 RACK MOUNTING ADAPTER KIT

INSTALLATION INSTRUCTIONS

For Use With

TR-888, 8 Channel Analog Recorder

This kit consists of the following items:

1. Rack Panel (qty.1) PN #600918
2. #8-32 x 1/2 button-head socket screws (qty.10)
3. Rubber Feet (qty.4) PN #103799

Install this kit as follows:

a. Place the recorder on its back.

b. Remove R.H. and L.H. side plates, and bottom plate, by removing all button-head cap screws. Plates will come straight off.

c. Align panel over recorder and fasten it in place by means of the hardware provided. Install all screws loosely at first, then tighten all screws alternately in an "X" pattern from top and bottom (first top right, then bottom left, then top left, etc.).

d. Install small rubber feet in bottom struts in place of button-head mounting screws which were removed.

e. Recorder may now be mounted in rack, using mounting hardware which is supplied with the rack by its manufacturer.

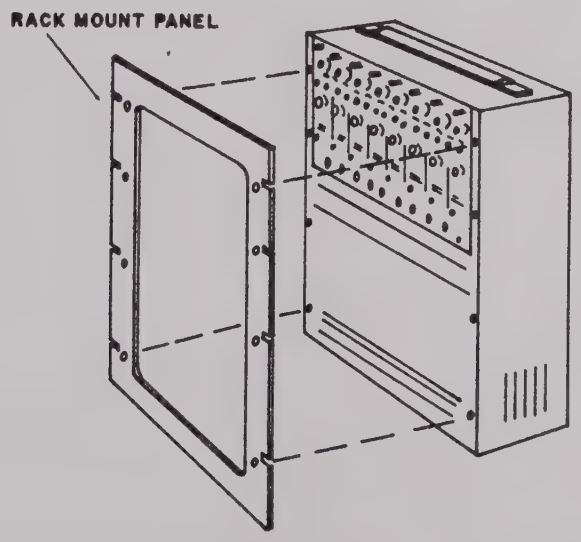
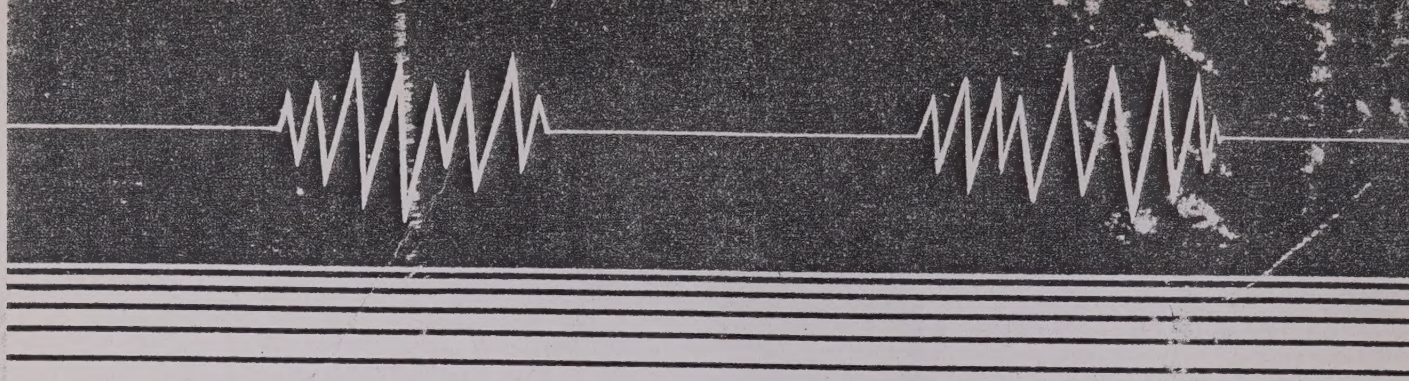


FIGURE 9-4. Rack mounting adapter kit



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